

IV. Core Elements

➤ HABITAT

Habitat is Key

FISH PASSAGE BARRIERS: PROVIDING ACCESS TO HABITAT

I. Current Situation: *Where are we now?*

Background

Upstream migration to spawning beds for adult salmon and instream migration for juveniles is fundamental to survival of the species. One hundred years of human development in Washington State's rivers and streams has created numerous barriers to salmon migration. Impaired fish access is one of the more significant factors limiting current salmonid production in many watersheds. See Chapter II. Background: Setting the Context for further discussion of impacts of barriers on salmon.

The purpose of this chapter is threefold: (1) to describe the types of human activities in or near stream channels that block or impair salmon passage; (2) to identify the strategies currently used by the state to rectify these problems; and (3) to outline the approach the Joint Natural Resources Cabinet (JNRC) proposes to strengthen these strategies and implement new ones in ways that promote voluntary, collaborative approaches, coupled with enhanced enforcement of existing laws.

It is important to note that resolution of fish passage and screening issues is in the implementation stage. The concerted efforts of the Washington Department of Fish and Wildlife (WDFW) the last two decades have elevated awareness to the extent that fish passage at least has had additional dedicated funds earmarked to accelerate barrier correction. This and the obvious correlation between salmonid production and the ability to access habitat have mobilized many governmental and private entities. Although fish screening has not had the same amount of attention, there is an increasing effort to bring this issue to the same level of focus as fish passage. This is appropriate given the difficulty in separating these issues, oftentimes at the same structure.

In the 1980s and extending to the present, WDFW created and refined a fish passage unit. The unit's primary responsibilities are to maintain databases on fishways and barriers, inventory road culvert barriers, inspect fishways and notify owners of maintenance needs, conduct workshops, and conduct construction projects to fix barriers. This unit has emphasized partnerships with legal jurisdictions to identify and correct high-risk barriers in a cost-efficient manner. Risk is associated with the size and gradient of the stream, which in turn requires more intensive design to reduce failure, destruction of property, and loss of fish. Various volunteer groups, with assistance from WDFW and the Conservation Commission, have also mobilized to identify and correct mostly privately owned barriers, which typically have lower risk.

Despite the passage of a fish screening law as early as 1905, WDFW was unable to enforce the law

requiring fish screens on irrigation diversions because of screening technology problems. Early fish screens were “*passive*” and required frequent manual cleaning by the water user, they were deemed impractical and soon abandoned by irrigators. It was not until self-cleaning screens were developed that the primary technical problems blocking implementation of a comprehensive, enforceable fish screening program, were resolved. The WDFW screening program has been built on a three-way partnership among diversion owners, the state, and federal government. Efforts are directed to screen construction, operation, inspection, and maintenance, often with reimbursable contracts. More recent efforts have also emphasized upgrades of screens to most recent standards utilizing federal (Bonneville Power Administration {BPA}- Columbia River) and/or state capital budget funding.

In 1987 the WDFW began an inventory of pump diversions in upper Columbia Basin tributaries supporting salmon and/or steelhead (non-anadromous areas excluded). This pump diversion inventory effort was extended in the 1990s with federal funding to the mainstem Columbia River (estuary to Chief Joseph Dam) and the Snake River. To date, about 1,100 pump stations of all sizes have been located. Typically, only 25 - 40 percent are adequately screened to protect salmonid fry from entrainment and impingement. Virtually all gravity diversions (canals and ditches) in "resident fish only" waters are believed to be unscreened. This is because gravity screens are relatively costly and complex (compared to pump diversions); require professional design and construction; and require more intensive operations and maintenance (O&M) oversight. Generally, gravity diversions are considered more injurious to fish than pump diversions of equal size (flow rate) because entrainment in a gravity diversion mimics natural, voluntary downstream migration into side channel rearing habitat.

The following is a more detailed description of barriers caused by specific activities:

1. Barriers Caused by Roads, Highways, and Railways

The Washington State Department of Transportation (WSDOT), Transportation Data Office, indicates that there are at least 80,000 miles of streets, roads, and highways in Washington (Table 6). In addition, the Department of Natural Resources (WDNR) through aerial photo interpretation, has estimated there are (including forest roads and other unpaved roads) approximately 170,000 miles of public and private roads in the state. Only a fraction of these roads have been inventoried for fish passage barriers.

Over 100 years of road building, development, and hydrologic changes have resulted in a minimum of 2,400 human-made barriers at road crossings. This number is extrapolated from data collected from surveys of less than 10% of the roadways of the state. An estimated 10% of the barriers are on state roadways, 40% on county and municipal roads, and the remainder of the barriers are on non-public and forest roads. These structures block fish access to an estimated 3,000 miles of freshwater spawning and rearing habitat. Most road-related barriers are the result of improperly placed or maintained culverts.

Table 6. Inventory of roads within Washington State, categorized by jurisdiction and total mileage.¹

Agency/jurisdiction		Mileage
Local		
	County roads	41,094
	City streets	12,910
	Port districts	2
	College and universities	123
	Total	54,129
State		
	Department of Transportation	7,040
	Department of Fish and Wildlife	1,929
	Parks and Recreation Commission	655
	Department of Social and Health Services	35
	Department of Natural Resources	9,500
	Department of Corrections	159
	Total	19,318
Federal		
	USDA Forest Service	5,453
	USDI National Park Service	270
	Department of Energy	154
	Bureau of Indian Affairs	902
	Total	6,779
Grand total		80,226

Culverts represent a substantial portion of fish passage barriers in state roads. Culverts may not have caused fish passage barriers when initially placed, but alterations to the stream channel may change stream velocity, gradient, or morphology. Insufficient maintenance may result in blocked culverts, down-cutting at the downstream culvert opening, water piping around the culvert, or, over time, general degradation of the culvert which results in leakage or collapse. These changes may cause a previously passable culvert to become impassable. In addition, some culverts were not originally designed to provide appropriate fish passage. Examples include undersized or steep culverts which increase velocity, inadequate jump pools at the downstream culvert entrance, or insufficient flow across the bottom of the culvert.

When highways are built along river bottoms, they may prevent lateral migration of the stream channel, which cause in-river barriers to develop over time. These barriers are not often attributed to the adjacent roadway, and are often difficult to correct. Further, some of the most productive rearing sites for juvenile salmon in streams are located in backwaters along the edge of the stream channel and in side channel areas. Highways built next to streams and rivers often disrupt access to these off-channel sites by physically isolating them from the main channels.

¹ These totals do not include roads under private ownership (railroads, timber holdings, agriculture, etc. adapted from Wagner and Sekulich 1997).

2. Barriers Caused by Water Diversion and Storage Dams

There are about 1,000 dams obstructing the flow of water on many streams in the state. These are structures that can store ten acre-feet or more of water. Dams are constructed from simple berms built with streambed materials to very complex dam systems that use a variety of pumping, screening, and other mechanisms. The uses for the water stored vary by regional principal uses in the Puget Sound Region are municipal, hydropower and industrial, whereas most water used in the Columbia River Basin is for hydropower and irrigation. Some storage dams serve several functions, such as flood control, water supply, recreation, and irrigation. (Hydropower dams are addressed in Chapter IV. D. Hydropower and Fish: Pursuing Opportunities.)

For many early storage and diversion dams, no fish passage facilities were constructed, resulting in the loss of several significant salmon runs. For example, irrigation reservoir storage dams in the Yakima River basin blocked sockeye runs estimated at 200,000 adult fish (Palmisano et al. 1993). At some irrigation impoundments, adult passage is hindered by poorly designed ladders and screens. Such dams not only prevent passage into productive spawning and rearing areas, but also destroy free flowing reaches of streams - either by impounding the reaches or causing unnatural sediment deposition. Dams slow rivers and turn them into a series of controlled reservoirs causing an unnatural flow regime and higher water temperature.

Irrigation diversions associated with dams range from small (a few cubic feet per second), to large (thousands of cubic feet per second). Unscreened or improperly designed diversion dams can impede upstream migration of adult salmon, alter the distribution of rearing juvenile salmon within the stream system, or actually cause the juveniles to enter the irrigation system (entrainment). In addition, juvenile fish can be impinged on the screen itself if it is not properly designed. Palmisano, et al. (1993), citing several studies by National Marine Fisheries Service (NMFS) found about 70% of the water diversions in Washington lacked proper screening in the late 1970s, and that 30% continued to be improperly screened or designed even after efforts to improve screening. For waters with resident salmonids only, virtually all gravity diversions are unscreened. Although the full extent of fish losses resulting from inadequate screening is unknown, it is well documented that significant injury and mortality occurs.

3. Problems Caused by Stream Channel Structures

Fish passage barriers include structures that were placed in the stream with little thought on salmon migration needs. Lake outlet screens were placed in the 1950's and 1960's to prevent the out-migration of hatchery trout from planted lakes, and to control lake levels. Most of these screens have been decommissioned, but those remaining often diminish spawning and rearing habitat for salmon.

Some fish hatcheries in the state impede salmon passage either through the water delivery system or the trapping system. Fisheries managers have used hatcheries for the purpose of increasing runs of salmon in Washington State. For some hatcheries with a goal to supplement natural runs, barriers are an important element. Trapping adult salmon enables fishery managers to achieve a number of objectives, including research, broodstock collection, and exclusion of some non-targeted fish. However, these facilities may delay passage of target and non-target species, displacement of spawners, and passage-related mortalities. Not all WDFW hatchery water intakes have fish screens that comply with WDFW's own current biological protection criteria. WDFW has inventoried all hatchery intakes and has developed a priority list for upgrade/replacement of inadequate screens.

Design, siting, and construction of hatchery barriers must include considerations of the seasonal movements and habitat uses of all species within that stream. An annual broodstock trapping and

release protocol should be established to ensure the needs of both the target and non-target species are considered. The broodstock traps should be monitored yearly, and the protocol should be revised accordingly to meet natural production needs.

Pump diversions can be difficult to detect, especially if there are no associated water control structures. They also can have a cumulative negative effect on instream flows when multiple pumps are operating simultaneously, especially in smaller tributaries.

Current Applicable Policies

As early as 1881, Washington residents recognized the need to preserve fish access to habitat and passed laws to prohibit the construction of human-made barriers. The legislature also recognized that unscreened irrigation diversions posed a serious threat to economically important salmon and steelhead runs and in 1905 required that water diversion owners install and maintain fish screens on rivers where state salmon hatcheries were located. Over the years, fish passage and screening laws have been amended a number of times to broaden the scope and provide greater protection for fish life. Fishway and fish screen replacement/upgrade authorization legislation was enacted in 1963 (RCW 75.20.061, RCW 77.12.425). Despite these laws, the state continues to have an acute problem of habitat loss and reduced salmon productivity due to non-compliance with fish passage and screening laws.

Based on the various statutory authorities relating to fish passage and screening, the Department of Fish and Wildlife adopted, on January 13, 1997, a policy on fish protection at water diversions/flow control structures and on fish passage. Below are specifically pertinent sections from that policy (POL-M5001), which is a cornerstone to the existing approach to address these issues.

“Purpose

This policy applies to water diversions and man-made fish passage barriers in all state waters. It compiles and defines Department application of state laws and applies to all state and private facilities and activities. Its purpose is to restore and maintain healthy fish populations by achieving compliance with state requirements to provide effective fish passage into and out of fish habitat and to prevent fish loss and injury to fish while diverting or controlling water from lakes, rivers or streams. This policy is important to restore fish populations that are at low levels and to maintain healthy fish populations.

1. Existing laws address fish passage; fish protection at water diversions and flow controls structures; actions that are necessary to construct, operate, or maintain devices that provide fish passage and protect fish; actions that adversely affect those devices; and fishing in those devices.

A. ...

B. ...

C. ...

D. A Hydraulic Project Approval (HPA) is required for construction, operation, or maintenance of a fishway, fish screen, bypass, or other fish guard. The Department will ensure coordination among the appropriate programs and divisions to facilitate a consistent, timely approach to fish passage and protection. Compliance with and onsite possession of the current edition of the Irrigation and Fish pamphlet constitute an HPA for non-equipment maintenance

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and operation of existing irrigation and stock-watering diversions.

2. *Remedies to illegal obstruction to fish passage can include collaborative plans.*
 - A. *Persons managing, controlling, or owning a dam or other obstruction across or in a river or stream shall remove the dam or obstruction or construct, operate, maintain and repair durable and efficient fishways approved by the Department for the purpose of allowing the free passage of fish around or through the obstruction. The Department must approve plans and specifications for the fishway prior to construction.*
 - B. *Fishways shall be operated, maintained, and continuously supplied with sufficient water to ensure the free passage of fish into and through the device.*
 - B....
 - B. *If the Director determines that upgrades to a previously approved fishway are necessary to meet a higher state of efficiency for the protection of fish life, the Department may remove, relocate, reconstruct, or modify the device, without cost to the owner. After the Department has completed the upgrades, the fishway shall be operated and maintained at the expense of the owner .*
3. *Remedies to illegal water diversions and flow control structures can include collaborative plans.*
 - A. *It is unlawful to divert water to control flow from a lake, river, or stream unless the water diversion or flow control structure is equipped with a fish guard to prevent the entry of fish into the diversion or flow control outlet and, if necessary, with a means of effectively returning fish from immediately in front of the guard to the waters of origin. The Department must approve the plans for the guard prior to construction.*
 - B. *The owner shall operate and maintain the fish guard in effective condition to prevent fish loss and injury as long as water is being diverted.*
 - C. ...
 - D. ...
4. *Failure to comply with Sections 2 and 3 above can result in criminal proceedings.*
5. *Illegal diversions and obstructions to fish passage are subject to judicial actions to enjoin a public nuisance.*
6. *There are exceptions to fish passage and protection laws that will be minimized wherever possible to ensure fish stock recovery and maintenance.*
7. *There are guidance documents (attached) to facilitate protection of fish at diversions and flow control structures and fish passage.*

The “Screening Requirements for Water Diversion” dated 6/29/95, the “Decision

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Guidelines for Fish Passage Barriers at Road Crossings” dated 7/23/96, the “Fishway Design Guidelines for Salmonids” dated 5/22/96, and the “Water Crossing Structures” dated 11/10/94, define the conditions required for acceptable fish protection and fish passage decisions and design. The HPA constitutes design approval. In addition, there is a protocol titled “New Fish Protection Technology Development” that prescribes the process for developing experimental juvenile fish protection concepts.”

The Washington State Legislature recognized the extent of the fish passage barrier problem in Second Substitute Senate Bill (2SSB) 5886 passed in 1997. The bill directed a task force of representatives from state and local governments, tribes, business, and environmental and regional fish enhancement groups to recommend how to develop a program to identify and remove fish barriers. As directed in the bill, the report of the task force (Wagner and Sekulich 1997) recommends: (1) coordination and priorities, (2) funding, and (3) needed legislative action.

Most of the analysis and recommendations by the task force focus on barriers caused by the transportation system, yet the principal components apply to other barriers as well. Studies assessing the degree of passage problems caused by factors other than roads are limited. One exception is a report generated by WDFW addressing barriers at its hatcheries (Barber et al. 1997). Comprehensive inventories have not been done in many areas of the state, so the locations of many barriers are unknown. In streams where inventories have been completed, priorities have often not been established to prescribe an order of correction, particularly from a watershed planning perspective. One recommendation from the Task Force included the creation of the Fish Passage Barrier Removal Grant Program by the passage of SSHB 2879 by 1998 Legislature.

In addition to the fish passage statutes, construction or modification of any dam or controlling works for the storage of ten-acre feet or more of water and the storage of water in any reservoir are governed by chapter 90.03 RCW - Water Code, chapter 43.21A RCW- Department of Ecology - Water resources, and chapter 86.16.035 RCW - Control of dams and obstruction. These laws are administered by the Department of Ecology, Water Resources Program.

Correcting the fish passage barriers and screening problems is a crucial component in the recovery of salmonids. In many cases the blocked habitat is in good condition and can be utilized as soon as access is gained. A significant amount of work is already underway to correct known barriers, especially culverts, and to properly screen diversions.

However, several issues must be addressed to remove fish passage barriers and screen diversions in a scientifically tenable and economically feasible manner. Perhaps more so than for other Core Elements of Recovery, the strategy must also have a well-defined means to establish priorities, because of the widespread nature of these problems and the limited funds available to meet all needs. Also to be successful in this strategy, the state will closely collaborate with the tribes, federal and local governments, irrigation districts, public utility districts, and private landowners during the development and implementation of regional and local watershed responses.

II. Goal and Objectives: *Where do we want to be?*

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Goal:

Ensure that usable or restorable habitat is accessible to wild salmon by removing existing barriers, preventing creation of new barriers, and screening all diversions.

Objectives:

- Complete watershed-based inventories and prioritization of fish passage problems.
- Correct existing barriers and screen diversions and prevent new passage problems.
- Create a comprehensive long-term funding strategy that uses federal, state, local and private dedicated funds and project mitigation funds to expand correction programs and monitor effectiveness of those programs.
- Use volunteer-based organizations where appropriate to gain the best use of limited funds.
- Develop better understanding of fish passage needs, especially juvenile salmon migration habits and needs.
- Integrate fish passage and screening activities into implementation of watershed planning and other planning and restoration efforts.

III. Solutions: *What is the route to success?*

To accomplish the goal and objectives, a sustainable fish passage barrier and screening program must be implemented to:

- Continue and expand comprehensive inventories that locate, assess, evaluate, and prioritize barriers and unscreened or inadequately screened diversions;
- Secure long-term funding, with emphasis on correction of high priority projects first to maximize salmonid production benefits, regardless of ownership, while still recognizing that project priorities can be stratified to take advantage of funds that can only be spent on specific jurisdictions. Also secure long-term funding program to continue and expand post-correction compliance monitoring and establish on-going maintenance and replacement programs to avoid creation of new problems;
- Coordinate design criteria and guidelines and implement guidelines to fix passage barriers owned by state, local and private parties;
- Implement screening program consistent with current regional protection criteria adopted by NMFS, WDFW, Oregon Department of Fish and Wildlife (ODFW), and Idaho Fish and Game (IFG) in 1995 and approved by United States Fish and Wildlife Service (USFWS)- for interim bull trout protection in 1998;
- Coordinate permitting activities, monitoring and data management, and compliance with fish passage and screening laws;
- Broaden the understanding of fish passage needs, especially juvenile salmonid migration habits and limitations and knowledge of fish passage and screening design and correction;
- Integrate fish passage and screening needs into land and water use planning to reduce the

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opportunity for additional problems to develop.

Watershed based inventory and prioritization

Inventory of fish passage barriers and unscreened diversions is a very important activity for the protection and restoration of salmonids. The results of recent inventories conducted by the state, tribes, and local and private entities have increased the awareness of fish barrier problems and their impacts on all salmonid species.

The intent of the inventory and punishment program is to identify and prioritize fish passage barriers statewide and develop a comprehensive database. It is estimated that less than 80% of the state has been inventoried. Before 1998, the most regimented fish barrier inventories were conducted by WDFW on the state highway system (using WSDOT funds) and on county-owned roads in Skagit, Kitsap, and Thurston counties, with a commitment from WSDOT and these counties to cooperate with WDFW in follow up correction efforts. Diversion inventories by WDFW concentrated on the mainstem Columbia River and Snake River and the anadromous portions of the tributary subbasins.

During the 1998 legislative session, \$5.75 million was included in the WDFW supplemental capital budget to address fish passage. Most of these funds were passed to WSDOT to administer a grant program, about \$700,000 of which was awarded to grant applicants for barrier identification and prioritization. Another \$270,000 is being used to inventory problems on WDFW lands and another \$120,000 to complete an inventory on county roads in Jefferson County. In addition, there were complementary operating funds appropriated to WDFW to provide technical assistance to these applicants and to formulate and maintain a centralized database to track the status of barriers, including priorities and correction status.

The Department of Fish and Wildlife (WDFW) has just completed a manual (Salmonid Screening, Habitat Enhancement and Restoration Division, 1998) that details the protocol for locating, assessing, and prioritizing barriers and for conveying the necessary information to WDFW for incorporation into a centralized database. The information will then be available to agencies and local interest groups. This effort offers a solid opportunity to build partnerships for watershed restoration, but falls short with respect to inventory and prioritization of inadequately screened water diversions. In preparation for possible funding increments to address diversion inventories, WDFW is preparing a protocol for fish screening assessment. It will be an added module to the manual, and will be available in the fall of 1999.

Support for the manual was expressed by the 1999 legislature through ESHB 2239. The bill required all agencies administering natural resources based grant programs that may include fish passage barrier removal projects to use fish passage prioritization selection criteria for inventory and correction contained in the WDFW manual.

In addition, a broad-based effort called the Watershed Recovery Inventory Project (WRIP), sponsored by WDFW, included workshops and surveys to solicit information on fish passage barriers from sources inside and outside the agency. Part of this effort resulted in a database directory that can be used for contacts to obtain more detailed information on a multitude of habitat issues. There are undoubtedly similar efforts and databases that have not been included in the WDFW database or in the WRIP directory. Examples include the efforts of the co-managing tribes of Washington State, Washington Rivers Council, Washington Trout, and various basin and watershed plans and assessment (sponsored through Forestry Module process, Conservation Districts, Washington State Department of

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Natural Resources, and U.S. Forest Service), independent county and city inventories, and assessments by various interest groups, volunteers, and private consulting firms.

The Washington State Department of Transportation (WSDOT) plans to address all fish barriers on state-owned highways located in the inventory with their 20-Year Plan. The 20-Year Plan is a three-pronged approach. It first designates highest priority fish passage barriers and systematically removes these barriers. Second, as projects requiring hydraulic permits are constructed, additional barriers are removed. And third, some fish barriers are removed as a result of WSDOT's routine maintenance activities (Johnson, et al. 1998).

The Washington State Department of Natural Resources (WDNR) has replaced over 100 large culverts in streams per year and in the past few years the replacements are generally in response to flood damage, evidence of an undersized culvert, or normal deterioration. Until recently no formal department program existed for fish barrier assessments or repairs. Some road maintenance managers have chosen to prioritize projects based on the evidence of apparent fish barriers. That is changing.

In 1997 the WDNR signed a Habitat Conservation Plan (HCP), which covers a variety of anadromous and resident fish species in Western Washington. One of the Riparian Conservation Strategies committed to in the plan includes the inventory, assessment, and prioritization for removal of roads causing fish blockages. Over the course of the current biennium, WDNR will be working with the appropriate state and federal agencies to formulate a strategy for completing this very sizable project. In addition the Forests and Fish Report (Summarized in Chapter IV. A. 2. Forests and Fish) requires inventory and assessment of the condition of existing forest roads and orphan roads constructed prior to 1974 and not used. See Appendix D. Roads, contained in the Forests and Fish Report, dated April 29, 1999. The fish passage concerns will be included in the state Forest Practice Rules.

Inventories for culverts on county roads have been conducted by WDFW and, in some cases, by the county. Thurston, Kitsap and Jefferson Counties along with Chelan, Snohomish, King, and Pierce Counties and the cities of Olympia and Tumwater have been the most active in barrier inventory and correction efforts. Funding appropriated by the 1999 legislature to the Salmon Funding Board may be available to state, counties and cities to continue the inventory program.

Engrossed Substitute House Bill 2496, Salmon Recovery Planning Act of 1998, Section 10 directs the Conservation Commission to form a technical advisory group to identify limiting factors for salmonids. ESHB 2496 Section 2 defines limiting factors as, "conditions that limit the ability of habitat to fully sustain populations of salmon. These factors are primarily fish passage barriers and degraded marine areas, riparian corridors, stream channels and wetlands". However, this language failed to address screening issues.

In order to meet this directive under ESHB 2496, the Conservation Commission has divided the state into seven geographic regions. The regions are consistent with the seven Salmon Recovery Regions identified in Chapter III. A Road Map to Recovery. The loss of access to freshwater and saltwater is a limiting factor in all of the regions. The habitat limiting factors analysis will be completed on a water resources inventory area (WRIA) basis. Fish passage barriers will be a priority item in the analysis of the limiting factors for salmonids in streams, rivers, tributaries, estuaries, and subbasins in the salmon recovery regions. The analysis will be completed for the seven regions in June 2001.

Information and data on known and potential barrier and screening problems is/will be collected and

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formatted into a geographic information system (GIS) as part of the watershed-based inventory. This allows coordination of barrier removal and screening with other habitat recovery efforts within a watershed. This information can be used in watershed management planning efforts. One component of the inventory and prioritization protocol used in the grant program ensures that data points are easily mapped.

State Actions for Effective Fish Passage

1. Address Fish Passage Comprehensively

- The state resources agencies (the Departments of Fish and Wildlife, Transportation, Natural Resources, and Ecology, and the State Conservation Commission) will collaborate with the tribes, federal and local governments, irrigation districts, public utility districts, and private landowners to identify, correct and/or remove human-caused fish passage and screening problems in freshwater, floodplain, and estuarine habitats. This effort will be integrated, as much as possible, into existing watershed management efforts, limiting factors analysis done under the Salmon Recovery Planning Act of 1998, and other planning and restoration efforts (e.g. flood reduction, and stormwater management). This will ensure that all potential blockages and diversions are assessed and correction and prevention projects and activities are coordinated with other protection and restoration efforts in the watershed.
- The state will support detailed studies and analysis to evaluate the biologic, economic, and societal impacts of removing or decommissioning large dams in areas where preliminary investigations show the dams are significant contributors to the limiting factors for salmon recovery and where mitigation is unable to address the problems. Studying dam removal does not, however, mean that the dam will be removed or breached.
- The Department of Fish and Wildlife (WDFW) will recommend changes to land use plans, shoreline management programs, stormwater plans and floodplain management plans to prevent any further impacts on fish passage from construction of roads, diversions, and other structures.
- WDFW will recommend fish passage and screening options at federally owned and operated dams to maximize effectiveness for juvenile and adult salmonid passage.
- The Departments of Fish and Wildlife and Transportation in collaboration with other agencies will explore alternative mitigation opportunities to address impacts of fish passage barriers both on-site and off-site, while recognizing that fish passage (access to habitat) and restoration of habitat productivity (integrity of habitat) are both necessary components to salmonid recovery. That is, trading one component for another does not truly fulfill recovery efforts. The state will rely on policy guidance designed by the mitigation work group established under the Salmon Recovery Planning Act, (ESHB 2496, Section 16).
- Comprehensive funding strategies will be implemented to use federal, state, local, and private dedicated funds and project mitigation funds to fix the most important problems first and fund maintenance and replacement to avoid future barriers. Volunteer-based organizations will be used, where appropriate, to gain the best use of limited funds.

2. Standardize Fish Passage Design

Design of barrier corrections and fish screens is site specific. Slight miscalculations in design or

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implementation can reduce the ability of the project to pass or protect fish. Inadequately designed culverts may quickly degrade in fish passage capability. WDFW engineers have compiled a design manual (Environmental Engineering Division, 1998) to facilitate training and technical assistance to those conducting design work on fish passage barrier corrections, which is available on the WDFW web site.

To increase potential for success, juvenile passage design standards need to be created and additional design options provided. These standards must be reviewed periodically with fishery scientists and engineers involved in designing and installing structures that may delay or impede salmonid passage. Existing structures must be reviewed on a periodic basis, to ensure that performance standards continue to be met.

3. Increase understanding of Fish Passage and Screening Needs

Both WDFW and WSDOT will continue ongoing training and education programs to make professionals aware of current fish passage and screening statutes, barrier identification, prioritization, and design criteria. WDFW will be supported in its efforts to establish firm guidelines on barrier and diversion assessment methods and establishing annual training courses in both protocol and design options.

Training of hydraulic engineers in fish passage barrier correction will continue to broaden fish passage barrier knowledge. WDFW now conducts periodic workshops for state, county, and city engineers and for agency personnel who work with volunteer organizations. These training and education efforts in concert with a substantive ongoing grant program are essential to lessen the time for correction of all barriers and inadequately screened diversions in the state, from 40-60 years to 20-30 years.

For some species, little is known about needs and extent of upstream movement and timing of juvenile salmonids. Steelhead, some chinook, and coho salmon spend a year in river systems before out migration. Over wintering habitat needs, flood incident needs, and seasonal stream use is not always understood. This knowledge is essential to the design of a comprehensive recovery strategy and determination of design flows for passage. Culverts that are currently designed for adult migration may be insufficient for juvenile migration.

There is also a lack of personnel with expertise necessary to organize and conduct expanded inventory, prioritization, design and construction work in fish passage and screening. Outreach and training materials and programs need further development to ensure that a consistent and systematic approach is taken to identify, prioritize, fund, design and construct corrections.

The Departments of Transportation and Fish and Wildlife received a grant from the Federal Highway Administration to research juvenile fish passage needs, and to create a comprehensive fish passage database for the Snohomish Watershed. Lessons learned on the Snohomish will be applied statewide as funds become available.

4. Streamline Permitting Process

During the 1998 Legislative Session, HB 2879 was passed to allow permit streamlining for certain types of fish habitat enhancement and restoration projects. Projects that meet the criteria established in the law, and do not have adverse environmental impacts that cannot be mitigated by the HPA are exempt from local permits and fees and do not require review under SEPA. This legislation enables some projects to move forward quickly with only an HPA from WDFW. This statute will be reviewed to ensure its broadest application, including federal cooperation in permit processing. (See Chapter V. C.

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Permit Streamlining)

5. Use volunteer support

Public outreach, education, and training are necessary for the Statewide Strategy to Recover Salmon to have an effective passage and screening program. Support networks of local partnerships and well-informed, active constituency operating on a watershed approach is crucial to continue accelerating fish passage and screening efforts. Better partnerships are needed with the numerous stream restoration and habitat groups that currently exist.

The state and its partners must promote correction efforts through the direct involvement of citizens that live and work within watersheds. The state will enlist volunteers and coordinate the efforts of Regional Enhancement Groups in programs that involve hands-on salmonid restoration efforts combining stream restoration with barrier removal and fish screening, particularly on low-risk projects.

6. Enforcement and incentives

The aggressive enforcement approach to correct fish screens is ineffective if the complexity and cost of the agency-approved fish screen is too great a hardship on the diversion owners and they choose to resist. Consequently, the WDFW seeks to reduce the hardship to a reasonable level by cost-sharing installation on gravity screens using capital budget funds. The "regulatory approach" has proven to be most effective where the owner's cost of compliance is less than the cost of resistance. WDFW has taken this approach with mainstem Columbia and Snake River pump diversions. A regulatory approach works better with pump diversions because as the cost of compliance increases with diversion size, the economic value of the water usually increases at the same rate. Owners of large, agri-business pump stations can afford to screen properly because of the revenues generated over many acres of irrigated cropland. Small pump stations irrigate few acres and yield smaller revenues, but the cost of screening is proportionately less.

7. Implement Comprehensive funding strategy

The pace of the efforts to remove or correct passage barriers and correct screening problems depends on a full inventory, funding availability, and a means to establish a collaborative process among owners of problem facilities and state and local governments.

Funding for barrier correction and screening has been insufficient to address the entire problem. The mean barrier correction cost from WSDOT's Fish Passage Grant Program is more than \$80,000. This program represents a broad variety of culvert barriers owned by both small and large jurisdictions. It is a good representation of current anticipated road related barrier correction costs.

Through 1997 an estimated \$4-6 million per year was spent on fish passage barrier corrections by state, federal and local agencies. With a conservative estimate of 2,400 road-related barriers statewide and an average cost of \$100,000 per barrier, under that funding level, it would take 40 to 60 years to address barriers created by existing roads within the state.

During the 1998 legislative session budget enhancement was approved, which provides funds for dedicated fish passage projects, along with barrier correction during road improvement projects when construction crews are already mobilized, and is expected to cut the time span in half. In addition, the Conservation Commission also works directly with private landowners to inventory and correct barriers, which helps ensure an accelerated process.

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An appropriation of \$5.75 million was included in the supplemental capital budget for fish passage barrier identification and removal. \$3.7 million of these funds were distributed through the Fish Passage Grant Program (ESHB 2879) to local governments, tribes, conservation districts and salmon enhancement groups.

The grant program as established by the legislature in HB 2879 requires a 25% match from the project sponsor. The remaining \$2.05 million was used to complement inventory efforts and fix priority barriers owned or identified by WDFW. About 80% of the total have been earmarked for correction of prioritized barriers. Design engineers from WDFW provide technical assistance in these correction efforts with workshops that began in October 1998, with the aforementioned design manual that will soon be available on the Internet, and direct interaction with engineers in other agencies to familiarize them with fish passage issues and design criteria.

In addition Congress has appropriated, for Federal Fiscal Year 1999, \$20 million to the State of Washington. The federal money was allocated to local governments for salmon and steelhead projects and activities. Some of the projects and activities submitted by local governments and approved by the Governor's Salmon Recovery Office, relate to fish passage barriers.

The Washington State Department of Transportation (WSDOT) dedicated Fish Passage Funds are used to correct barriers on state owned roads that were identified with the Priority Index model method referenced in the protocol manual. The higher priority projects are addressed before those with lower priority ratings. WSDOT Road Work Funds (also known as Safety Mobility Funds) are used to correct barriers that are affiliated with scheduled roadwork on public roads. These barriers do not necessarily have a high Priority Index rating, but since roadwork is already being conducted, the barrier problem is corrected to take care of two problems at once. It is more efficient to do the barrier correction while work crews are already on site because the equipment is already mobilized. In this way, some costs of construction are already covered.

For the 1999-01 biennium the legislature appropriated over \$10 million dollars to WSDOT to invest in fish passage barrier removal projects and stormwater retrofit projects. This is in addition to the \$4 million in WSDOT base program. About \$119 million dollars of federal and state funds were also appropriated by the legislature for salmon recovery. The newly created Salmon Recovery Funding Board will administer the funds. A significant percentage of the funds could be provided for fish passage barrier correction and fish screens.

In addition, some base level funding, less than \$2 million a year, for correcting screens is provided by Bonneville Power Administration (BPA). About half of this amount goes from BPA to United States Bureau of Reclamation (USBR) for screen design and civil works in the Yakima River system and the other half is used by WDFW in its screening program.

IV. Monitoring and Adaptive Management: *Are we making progress?*

A monitoring protocol will be developed to gauge the success of fish passage and screening corrections. The monitoring protocol will address both adult and juvenile fish passage. Baseline and post correction data must be collected and analyzed through an established program. Funding for monitoring is needed.

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The monitoring program will include the following elements:

1. *Implementation*

- Review whether a sustainable fish passage and screening program has been established,
- Have sufficient funding sources been established?
- Review whether inventories and prioritization of blockages and diversions to be fixed have been established,
- Once the program is established and funded, review progress for correction relative to schedule.

2. *Effectiveness*

- Establish a Quality Assurance/Quality Control procedure for review of corrected problems.

3. *Validation*

- Sample corrected barriers to ascertain upstream/downstream migration by adults and juveniles and sample screened diversions to ensure fish protection.
- Data collection, analysis, and dissemination are critical components of an effective passage and screening program. Many problems have been identified but more exist.
- Additional inventories are needed to plan and effectively prioritize correction work within a watershed. Inventories must include barriers on city, state, federal, tribal, and private lands and the remaining county roads. Diversion inventories must be expanded to western Washington and to resident fish only waters. Inventories should follow established protocols.
- Support is needed to standardize fish barrier and diversion databases, coordinate data collection and centralized data access, and coordinate work among watershed planners, road managers, resource agencies, tribes and non-governmental organizations within the watershed to ensure that all potential problems are assessed. In this way, the priorities of all barriers and diversions within the system can be compared and the most cost-effective projects done first.
- Development and maintenance of a GIS-based, Internet-accessible database of fish blockages and diversions statewide is also essential. In addition, data compilation of hydrologic data and fish species distribution information would be invaluable in promoting quality assessment and design work.
- Continuous monitoring and maintenance of existing structures is an integral part of an effective passage and screening program. For example, a road culvert may not be a fish passage barrier when initially installed, but could become a barrier due to debris blockages, down-cutting at the downstream culvert opening, upstream piping around the culvert, or, over time, general degradation of the culvert which results in leakage or collapse.

In most instances, a degraded culvert will continue to meet its primary function, moving water under the roadway. As such, road maintenance engineers need to be aware of the inspection and maintenance needs of each potential barrier to ensure continuous fish passage and prevent

a facility from degrading to the point of an unnecessary major rebuild.

The Department of Fish and Wildlife (WDFW) has an established inspection program for monitoring performance and maintenance of gravity diversion (canals and ditches) fish screens in anadromous waters. Unfortunately, this accounts for less than 200 individual diversions statewide, although these sites are among the largest and potentially most detrimental diversions to fish life in Washington. All fish screens are subject to loss, damage and deterioration over time.

- An on-going monitoring program to verify screen condition/compliance is necessary to assure that juvenile fish continue to be protected after initial installation, particularly on pump diversions where the screen is totally submerged and not easily inspected. Because the vast majority of diversions in the state (estimated to number in the thousands) are pump diversions, periodic inspections of each pump diversion screen (e.g. a ten-year cycle with 10 percent inspection rate each year) accompanied by database maintenance and compliance correspondence to diversion owners, will protect the capital investment in new screens. An alternative approach might be to inspect high priority pump diversions on a more frequent basis (e.g. a three or five-year inspection cycle).

Default Actions

The theme for the Statewide Strategy to Recover Salmon calls for agencies to use collaborative, incentive-based approaches when working with private and other governmental parties to recover salmon. Examples include the WSDOT Fish Passage Grant Program and the WDFW outreach program with counties and cities that includes an inventory conducted at state expense, provided agreements are made where corrections made by WDFW are reimbursed and the jurisdiction follows through with correction of remaining barriers.

For fish passage and screening, a potential default action would be to require the removal of the barriers using enforcement tools under the fish passage and screening laws described in section I. B, in the cases when barrier or diversion owners prove uncooperative.

ESA Compliance Strategy

State and local agencies are pursuing various options to address ESA uncertainty as it relates to correction of existing barriers and construction of new structures such as culverts. The following is a listing of some of the efforts being pursued:

1. Exceptions under 4(d) rules governing several ESUs (i.e., Puget Sound chinook, Lower Columbia steelhead) for habitat restoration activities specifically for correcting road and stream crossings including culverts, and to eliminate push-up dams to allow or improve fish passage.
2. Exceptions under a programmatic 4(d) rule and eventually an incidental take permit under a programmatic HCP for the Forests and Fish. (See Chapter IV. A. 2. Forests and Fish.)
3. Incidental take statements under ESA section 7 consultation for WSDOT construction projects funded by Federal Highway Administration (FHWA).
4. Incidental take statements under ESA section 7 consultations for land and water activities authorized, funded or carried out by the U.S. Corps of Engineers, US Forest Service, US Bureau of Reclamation, Federal Emergency Management Agency, and other federal land and water

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management agencies. Specifically this pertains to irrigation diversion screens, dams, levees, dikes and other instream structures.

5. Incidental take permits under programmatic section 10 HCP for the Hydraulic Project Approval and possibly other permits.